# 3.0 Reconnaissance

## 3.1 Initial Entry Into Residential Home

Residences potentially contaminated with mercury should be prescreened by U.S. EPA or Superfund Technical Assessment and Response Team (START) personnel using a mercury vapor analyzer, such as a Jerome Mercury Vapor Analyzer (MVA) and/or a Lumex Mercury Analyzer (Lumex). Information regarding two additional mercury vapor analyzers available but yet to be used in Region 5 is provided in Sections 3.4 and 3.5. Individuals conducting air monitoring should follow his or her company's health and safety plan protocols prior to initial entry. Individuals entering the area in Level C personal protective equipment should use mercury vapor cartridges in their air-purifying respirators. These cartridges filter low levels of mercury vapor.

If initial prescreening air sampling using a MVA detects concentrations greater than 0.01 milligram per cubic meter ($mg/m^3$) (or 10 $\mu g/m^3$) throughout the residence, individuals should immediately inform the agency responsible for relocation that temporary relocation of the residents may be considered pending National Institute for Occupational Safety and Health (NIOSH) Method 6009 sampling. NIOSH Method 6009 is a laboratory analytical method to analyze long-term air samples. Sections 3.6 and 3.7 provide information regarding air sampling. NIOSH Method 6009 can be used to establish a more accurate estimate of the mercury concentration in the residence. If prescreening air monitoring results from a MVA detects concentrations consistently less than 0.01 $mg/m^3$ (10 $\mu g/m^3$), an air sample should be collected and analyzed using NIOSH Method 6009.

**NOTE:** The Jerome MVA is realistically accurate when mercury vapor concentrations are 0.01 $mg/m^3$ (10 $\mu g/m^3$) or greater. The Lumex can detect mercury vapor concentrations as low as 2 nanograms per cubic meter ($ng/m^3$) or 0.002 $\mu g/m^3$.

## 3.2 Jerome MVA

The Jerome MVA (Photograph No. 3-1) uses a patented gold film sensor for the detection and accurate measurement of mercury vapor in the air. When the sample cycle is activated, the internal pump draws a precise volume of air over the gold film sensor. Mercury vapor in the sample is adsorbed and integrated by the sensor, registering it as proportional change in electric resistance. The instrument computes the concentration of mercury in $mg/m^3$. The gold film sensor is inherently stable and selective to mercury, eliminating interferences common to ultraviolet analyzers, such as water vapor and hydrocarbons. When the gold film becomes saturated, the instrument is placed into regeneration mode to "burn off" the mercury vapors attached to the gold film.

The range of detection on Jerome MVAs varies according to the model of the instrument.

- Jerome MVA Model 411: 0.001 to 1.999 $mg/m^3$
- Jerome MVA Model 431: 0.001 to 0.999 $mg/m^3$

The sensitivity of both instruments is 0.003 $mg/m^3$ Hg, and the accuracy of both instruments is ± 5% at 0.100 $mg/m^3$ Hg.

**NOTE:** Realistically, the Jerome MVA is accurate only when mercury vapor concentrations are greater than 0.01 $mg/m^3$ (10 $\mu g/m^3$). Therefore, all residential air sampling should be confirmed using NIOSH Method 6009 (see Section 3.7). Jerome MVA interferences include smoke, nitrogen, and sulfide compounds.

**Photograph No. 3-1**


**View of the Jerome MVA.**

## 3.3 Lumex RA-915+ Mercury Vapor Analyzer

The Lumex RA-915+ (Photograph No. 3-2) is a portable atomic absorption spectrometer designed to determine the mercury vapor content in ambient air, water, soil, and natural and stack gases. It has a built-in compressor and internal rechargeable source, as well as a car adapter, for field monitoring in remote areas. This instrument can detect low-level mercury vapors. The following are specifications for the Lumex RA-915+.

- It is a high sensitivity instrument that does not require gold amalgam preconcentration and subsequent regeneration steps; this enables the user to conduct real-time monitoring.
- Data collection and data logging are conducted in real-time and stored as a separate file.
- Low mercury detection limits and the sensitivity of the device are achieved through a combination of 10-meter multi-pass optical cells and Zeeman Atomic Absorption Spectrometry using High Frequency Modulation.
- **There are no known interferences with this instrument, but high humidity has been shown to give false positives.**
- The detection range of the Lumex RA-915+ is 2 ng/m$^3$ to 26 µg/m$^3$ in air.
- The sample volume is set at 20 liters per minute.
- The instrument features an on-board display with a set point level alarm.

Distributor: Ohio Lumex Company, Inc. 216-642-9700 **www.chemanalysis.com**

**Photograph No. 3-2**


**View of the Lumex RA-915+ MVA**.

## 3.4 VM-3000 Mercury Vapor Monitor

The VM-3000 Mercury Vapor Monitor (MVM) serves for continuous measurement of mercury vapor. The mercury concentration is measured in an optical cell made of fused silica. A maintenance-free membrane pump continuously feeds the sample gas to the optical cell where light absorption is measured. This so-called "cold vapor" measurement method is extremely sensitive for mercury vapor determination. In contrast to the occasionally recommended atomic fluorescence method, it is low in interference and requires neither an amalgamation step nor expensive noble gases as carriers.

The VM-3000 (Photograph No. 3-3) uses a high-frequency driven electrodeless, mercury low pressure lamp as its ultraviolet source. The VM-3000 generates emission lines of an extremely narrow bandwidth that are congruent with the absorption lines of the mercury atoms, therefore, cross sensitivities are minimized. To prevent temperature drift, both the lamp unit and the detectors are temperature-stabilized. Because the optical cell is heated, the VM-3000 is insensitive to water vapor.

The measuring range of the VM-3000 can be adjusted from 0.1 to 100 µg/m$^3$, 1 to 1,000 µg/m$^3$, or 1 to 2,000 µg/m$^3$.

The cost of the VM-3000 (300-00X) is approximately $9,532. The cost of a data logger that can store 15,000 measurements is $361, and an optional wand and tubing is $115.

**NOTE:** As of the publication date of this document, U.S. EPA has not used this product on any mercury responses in Region 5.

Distributor: Service Technologies, Inc. 303-972-3740 **www.st2-service.com**

**Photograph No. 3-3**

**View of the VM-3000 MVM.**

## 3.5 Nippon Portable Mercury Survey Meter

The Nippon EMP-1A (Photograph No. 3-4) provides real-time accurate data using the Cold Vapor Atomic Absorption method, solving the problem of real-time on-site measurement of mercury gas concentrations. The advantages of the EMP-1A are the following:

- Real-time measurements
- Automatic zeroing
- Avoids trapping mercury in acidic solution
- Avoids amalgam methods
- Avoids gold thin-film procedure

The EMP-1A has a detection range of 0.001 $mg/m^3$ to 5.00 $mg/m^3$ (1 $\mu g/m^3$ to 5,000 $\mu g/m^3$). The EMP-1A measurements are not affected by common chemicals, but interferences may occur when extremely high concentrations of acetone and carbon tetrachloride are encountered.

The cost of the EMP-1A is approximately $15,000. Additional accessories include a carrying case and a probe (with dust filter).

**NOTE:** As of the publication date of this document, U.S. EPA has not used this product on any mercury responses in Region 5.

Distributor: SMG/interlink 800-804-6196 **www.smglink.com**

**Photograph No. 3-4**


**View of the Nippon EMP-1A Mercury Survey Meter.**

## 3.6 Air Sampling Equipment

Sampling pumps that may be used to collect air samples include the Gilian™, MSA Flow-Lite with optional Gemini™ "low flow" adapter, or SKC air sampling pumps (Photograph Nos. 3-5 and 3-6).

**Photograph No. 3-5**


**View of the Gilian™ GilAir5 air sampling pump and the BIOS DryCal™ DC-Lite primary flow meter.**

**Photograph No. 3-6**

**View of the Gilian™ GilAir5 air sampling pump being calibrated with the BIOS DryCal™ DC-Lite primary flow meter.**

The following types of sorbent tubes may be used for air sampling (Photograph No. 3-7).

Supelco 1-800-247-6628

| | |
|---|---|
| Size: 6 x 70 millimeters (mm) | Size: 8 x 110 mm |
| 200 milligrams (mg) | 500 mg (if expecting high mercury concentrations) |
| ORBO-1002 hopcalite Part# 20863 | ORBO-1008 hopcalite Part# 20866 |
| $ 76.50 for a box of 50 tubes | $ 128.80 for a box of 50 tubes |

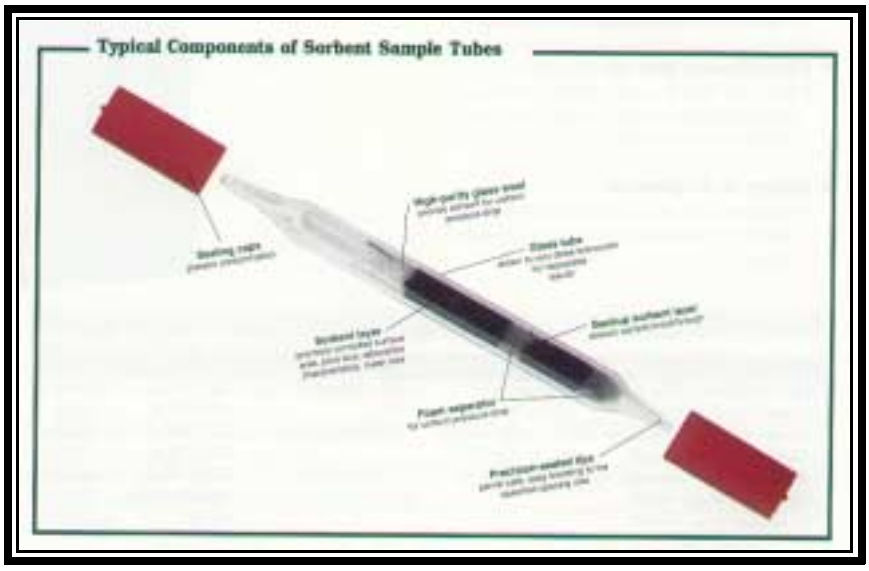
Note: Use Gilian™ sorbent tube holder model S-225 for 200 mg tubes and Gilian™ sorbent tube holder model THH-L-240 for 500 mg tubes.

SKC 1-800-752-8472

| | |
|---|---|
| Size: 6 x 70 mm | Size: 8 x 110 mm |
| 200 mg | 500 mg (if expecting high mercury concentrations) |
| Catalog # 226-17-1A carulite (HYDRAR) | Catalog # 226-17-3A carulite (HYDRAR) |
| $ 72.00 for a box of 50 tubes | $ 121.00 for a box of 50 tubes |

Note: Use Gilian™ sorbent tube holder model S-225 for 200 mg tubes and Gilian™ sorbent tube holder model THH-L-240 for 500 mg tubes.

**Photograph No. 3-7**




**View of a sorbent sample tube**

## 3.7 Confirmatory Air Sampling Procedures

Laboratory air sampling should be conducted using NIOSH Method 6009 or a modified NIOSH Method 6009. See Attachment D for a copy of modified NIOSH Method 6009 written by U.S. EPA's Environmental Response Team (ERT). A copy of NIOSH Method 6009 is in Attachment D. The analytical method detection limit should be set at 0.1 $\mu g/m^3$.

The sampling height of the sorbent tube should be set from 18 inches to approximately 3 feet (Photograph No. 3-8). This height simulates the breathing zone for children. The location of each sampling pump should be in an area of the home where maximum exposure to mercury vapor contamination would occur, such as the bedrooms and the living room.

**Photograph No. 3-8**

**View of the sampling height of the sorbent tube.**

The sampling flow rate for NIOSH Method 6009 should be set at approximately 150 to 250 milliliters per minute (mL/min). A longer sampling duration will give a greater air sample volume, which will lower the detection limit. A sample duration of 6 hours 30 minutes using a flow rate of 250 mL/min will give a total sample volume of 97.5 liters. Consult a commercial laboratory for verification of required sample volume for analysis. Page 3-11 provides an example of an air sampling data sheet.

For quality assurance, field blank sorbent tubes should be submitted with the samples. The laboratory should analyze one open field blank (handled with the real samples) and two filter

media blanks (unopened). Contamination in blank sorbent tube samples has shown up in laboratory analytical results.

At past time-critical mercury responses, U.S. EPA's ERT has developed and used a "modified" NIOSH Method 6009 analysis. The modified version consists of using a 500-milligram sorbent tube instead of the 200-milligram tube as specified in NIOSH Method 6009. The 500-milligram tube has been used in situations where mercury vapor concentrations are expected to be above background. The 200-milligram tube is used for post decontamination confirmatory sampling. In addition, the "modified" NIOSH Method 6009 analysis uses a flow rate of approximately 500 mL/min and a sampling period of 6 to 7 hours. This rate provides a total sample volume, using the 500-milligram sorbent tube, of approximately 180 to 210 liters.

NIOSH Method 6009 and the "modified" versions are acceptable to use at a site. The analytical laboratory should be familiar with the air sampling procedure used at a specific project.

Analytical costs:

The cost to analyze a sorbent tube at a commercial laboratory for mercury with 24-hour turnaround analysis is approximately $60 to $75 per sample.

# Air Sampling Data Sheet

**Site:** _____

**Project Number:** _____

**Date:** _____

**Page:** _____ **of** _____

| Sample Description/Location | Sample No. | Pump ID No. | Flow rate, L/min | | | Time | | Duration, minutes | Air volume, Liters |
|---|---|---|---|---|---|---|---|---|---|
| | | | Start | Stop | Avg. | Start | Stop | | |
| | | | | | | | | | |
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| | | | | | | | | | |
| **Entries by:** | | | | | | | **Date:** | | |

**Note:** Take at least 5 airflow readings, average them, and then enter into the table before and after the sample location event.

**Comments:** _____

## 3.8 Mercury Vapor Action Levels

In U.S. EPA Region 5, if air concentrations of mercury are 1 $\mu g/m^3$ or lower, cleanup is not considered necessary. **Attachment E** provides "Suggested Action Levels" for residential, commercial, and homes or businesses with indoor gas regulators as established by ATSDR. If the concentration is higher, clean-up goals should be discussed with a representative of the appropriate local, state, and/or federal health agency. Table 3-1 provides examples of action levels within a residential home.

The public health representative will help establish an appropriate clean-up goal based on the unique conditions and circumstances of each site. Factors that may influence the clean-up goal include age, health status, and pregnancy status of residents and other potentially exposed individuals; symptoms experienced by exposed individuals; the time each individual spends in the contaminated area; the time that has elapsed since the spill; and factors that may vary at each spill site.

No regulatory standards are applicable for the cleanup of elemental mercury. Health professionals use available human health research and data to evaluate the quantity of mercury likely to cause harm to humans under various circumstances. The procedure for evaluating mercury cleanups in U.S. EPA Region 5 is as follows:

- The OSC or U.S. EPA contractor conducts a thorough cleanup of a mercury spill.
- Once the clean-up effort is completed, air sampling is conducted using NIOSH Method 6009.
- The OSC or U.S. EPA contractor sends air sampling results to ATSDR or its cooperative agreement partner for evaluation:
    - ATSDR Region 5 office: (312) 886-0840
    - ATSDR Headquarters, Atlanta, Georgia: (404) 639-6360 (daytime) or (404) 639-0615 (24-hour response line).
- ATSDR or its cooperative agreement partner at the state health department determines whether it is appropriate to authorize reoccupation of the residence.

**TABLE 3-1**

**EXAMPLE ACTION LEVELS**

| Action Level | Mercury Vapor Levels | Health Department Action | EPA Decontamination Procedure |
|---|---|---|---|
| Level 1 | 10.0 $\mu g/m^3$ or greater | Relocate residents immediately. | See Section 5.5; Decontamination Procedure |
| Level 2 | Greater than 1.0 $\mu g/m^3$ but less than 10.0 $\mu g/m^3$ | Schedule relocation for the residents as soon as possible. | See Section 5.5; Decontamination Procedure |
| Level 3 | 1.0 $\mu g/m^3$ or less | No action necessary. | None. |

Key: $\mu g/m^3$ = Micrograms per cubic meter.